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Radiation protection principles observance in Iranian dental schools

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Background: In recent decades many guidelines has been conducted by radiation protection organizations about radiation protection in dentistry. This study aimed to evaluate the observance of these guidelines in educational clinics of all dental schools in Iran. ***Material and Methods:*** In this cross-sectional study a self-administered questionnaire, based on National Radiation Protection Board (NRPB) and European Commission guidelines, was conducted. The radiology departments of all dental school (18 schools) were surveyed in this study. The questionnaire was consisted of 3 sections including intraoral radiography, extraoral radiography and implementation of quality control programs. ***Results:*** In the case of the existence of radiation protection facilities (such as lead apron, thyroid shield and lead impacted walls) the use of high speed films and existence of automatic processor in dental schools, there was a proper condition. The main problem was related to lack of regular quality control and quality assurance programs. Digital radiography systems were employed in none of the schools and it was occasionally used for research purposes at some of them. ***Conclusions:*** This study has emphasized on the need for further consideration of radiation protection principles in dental schools, especially on the field of quality control and quality assurance programs. **Iran. J. Radiat. Res., 2010; 8 (1): 51-57**

Keywords: *Radiation protection, dental schools, radiography.*

INTRODUCTION

The average radiation dose, annually received by general publicm is 2.5msv, and 15% of them are related to medical exposures [1, 2]. The use of radiation in the medical practice has evolved since its beginning and 30% to 50% of medical decisions are affected by radiologic examinations.[3] However, the hazards of Ionizing radiation are irrefutable [1-3]. According to recently studies in United Kingdom was estimated that 100-250 death per year occurred because of harmful effects of medical radiation exposures [1, 4]. Reducing the patients received dose as low as reasonably achievable (ALARA) is based on the recommendations of all radiation protection organizations such as ICRP and NRPB [1-4].

Dental radiography represents one of the most frequently used radiologic examinations in the industrialized world. The hazards involved with dental radiography are certainly small.[5] However, this type of radiography stands for 25% of the radiologic examinations performed in the European Union [6-8]. It means that the dose to the population as a whole is considerable. Therefore some particular attention should be pay to radiation safety and dentists must keep up to date with changes in techniques and equipment and modify their own practice [7-10].

Significant decreases in radiation dose of dental radiography occur with the use of faster image receptors [11-13], intra-oral film holders, rectangular collimation for bitewing and priapical radiography [6], and also use of long, rectangular position indicating devices [14]. Moreover, leaded rubber aprons and thyroid collars have been shown to minimize X-ray exposure to various parts of the body [15].

Implementation of quality-control programs including periodic checks of films, processing chemicals, darkroom lighting, and X-ray units, helps maintain a high level

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of radiographic quality and subsequently results in fewer re-exposures [15].

International commission for radiation protection (ICRP) is the regulatory body which lays down guidelines for radiation protection at the international level [5]. In Iran, the Atomic Energy Organization of Iran (AEOI) regulatory board is the organization which provides the standards for radiation protection. But, there was not any widespread guideline about radiation protection in dentistry, and radiation health providers encourage responsible persons to obey from international guidelines about radiation protection principles.

The European Commission (EC) and National radiation protection board (NRPB) have been collected some guidelines about radiation protection in dentistry [16-18]. These guidelines cover broad areas for the dental practice, including intraoral and extraoral radiographies [16].

Observance of radiation protection principles in educational centers, like as dental school, where practicing dentists are trained, affords reducing patient dose and more ever is an effective way to instruction to students of dentistry.

The aim of this study was to investigate the radiation protection principles observance in Iranian dental schools. The objectives were to determine radiation protection principles observance in intraoral, extraoral radiography and utilizing regulatory quality control measurements in radiology departments of dental schools.

MATERIALS AND METHODS

The cross- sectional questionnaire based study was conducted between September 2008 and February 2009. The questionnaire was conducted regarding to European Commission [17] and NRPB [18] recommendations about radiation protection in dental radiography. The radiology departments of all dental school of Iran (18 schools) were surveyed in this study. Questionnaires were completed by direct interview with directors of Oral and Maxillofacial Radiology in 10 dental schools. Other Questionnaires were mailed to directors of radiology departments at the remaining 8 dental schools. Three directors did not send the questionnaires back and their questionnaires were completed by telephone interview with other responsible persons.

The questionnaire was consisted of 3 sections. The first section was about intraoral radiography (IR), and respondents were asked for information regarding film speed, the length and shape of position indicating devices (PIDs), the existence and policy for the use of protective covers (like as lead rubber aprons and thyroid collars), responsible person or persons for performing the radiography and holding the disable patients, KVp settings, tube filtration, type of protection for adjacent areas of exposure rooms and the use of digital radiography. Questions pertaining to extraoral radiography (ER), in the second section, solicited information about film-screen combinations, and the other dependent items that mentioned in IR section. The last section of the questionnaire was related to quality control programs and frequency of the quality control tests, such as tests for base-plus-fog (B+F) density, darkroom lighting and safe light condition, monitoring the exposure received by personnel, as well as quality control of the X-ray units and measuring the radiation parameters. As a result, information was obtained from all 18 dental schools, for a 100% response rate.

RESULTS

The responses to several questions, directly related to intraoral radiography, are overlay shown in table 1. The least commonly used methods, in this respect, was about the use of rectangular collimation and proper PIDs, and the commendatory items were the widespread use of E-speed

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film and adequate protection of adjacent areas of exposure rooms. It must be noted that none of schools were using rectangular beam limitation exclusively, and the most frequent PID was around PID with an 8 and 12-in source-film distance (38.9%). Fourteen dental schools (77.8%) had digital radiography facilities, but it was not routinely employed in none, and they only were used occasionally for research purposes at some of the schools.

The compiled results of extra-oral radiography are indicated in table 2. As manifested in this table, all schools of dentistry reported the use of rare earth intensifying screens for ER (100%). Direct digital radiography is available for extraoral imaging at 3 dental schools (11.1%), but all of respondents indicated that these systems are useless and rarely used for research purposes.

Leaded rubber aprons are used for pregnant women undergoing intraoral and extraoral radiographic procedures at all dental school, but one. The most commonly used method for protection of adjacent areas of exposure rooms was leaded walls in both intraoral and extraoral radiography.

As shown in table 3, regular quality control programs such as sensitometric testing and measurement of the base-plus-fog density of films, radiation output measurements, evaluation of the darkrooms for light leakages and adequacy of safe lighting, were performed at a few schools. Regular measurement of radiation received dose by personnel using film badges and the existence of automatic processors, for both intra and extra-oral radiography, were satisfactory items.

Agreement of the obtained results with some recommendation of European Commission [17] and NRPB [18] are shown in table 4 and figure 1.

Table 1. Status of dose saving practices in intraoral radiography (IR) practices in Iranian dental schools.

Intraoral radiography N (%)				
Film speed	D-Speed 0 (0)	D&E Speed 3 (16.7)	E-Speed 15 (83.3)	F-Speed 0 (0)
PID type	Round 16 (88.9)	Rectangular 0 (0)	Round or rectangular 2 (11.1)	Cone 0 (0)
PID length	< 8 inch 1 (5.5)	8 inch 7 (38.9)	12 inch 7(38.9)	≤ 16 inch 3 (16.7)
Protective covers	Lead apron only 11 (61.1)	Thyroid collar only 0 (0)	Both 7 (38.9)	None 0 (0)
Protective covers usage	Pregnant women 11 (61.1)	Pregnant women &childs 2 (11.1)	Pregnant women, childs & Full mouth series 5 (27.8)	All patients 0 (0)
Performing the radiography	Students only 4 (22.2)	Radiology technicians only 1 (5.6)	Dentists only 2 (11.1)	Occasionally 11 (61.1)
Holding disable patients	Dentist 0 (0)	Patient's attendances 18 (100)	Technician of radiology 0 (0)	nurses 0 (0)
kVp setting	< 60 KVp 0	60 KVp 2 (11.1)	61-70 KVp 12 (66.7)	> 70 kVp 4 (22.2)
Tube filtration	1 mmAl ≤ 0 (0)	1.5 1 mmAl 8 (44.4)	2 1 mmAl 10 (55.6)	> 2 mmAl 0 (0)
exposure room protection	leaded wall 16 (88.9)	Distance –direction law 0(0)	Adequate thickness of gypsum or concrete 2 (11.1)	lead partitions 0 (0)

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Table 2. Status of dose saving practices in extraoral radiography (ER) practices in Iranian dental schools.

	Extraoral radiography N (%)			
Film-screen speed	100 ≤ 0 (0)	200-300 0 (0)	400 ≥ 18 (100)	Digital radiography 0 (0)
Protective covers	Lead apron only 15 (83.3)	Thyroid collar only 0 (0)	Both 3 (16.7)	None 0 (0)
Protective covers usage	Pregnant women 12 (66.6)	All patients 4 (22.2)	Pregnant women & Childs 1 (5.6)	None 1(5.6)
Performing the radiography	Students only 2 (11.1)	Dentists Only 2 (11.1)	Technician of radiology only 11 (61.1)	Occasionally 3 (16.7)
Holding dis-able patients	Dentist 0 (0)	Patient's attendances 18 (100)	Technician of radiology 0 (0)	nurses 0 (0)
kVp setting	< 60 KVp 0	60 KVp 0 (0)	61-70 KVp 9 (50.0)	> 70 KVp 9(50.0)
Tube Filtration	1 mmAl ≤ 0 (0)	1.5 1 mmAl 0 (0)	2 1 mmAl 8 (44.4)	> 2 mmAl 10 (55.6)
Exposure room protection	Leaded wall 18 (100)	lead partitions 0 (0)	Adequate thickness of wall 0 (0)	Distance –direction Law 0(0)

Table 3. Status of dental school regarding to quality control periods.

	Quality control periods			
	Monthly or shorter	Monthly-annually	Irregularly	Not done
B+F density of intraoral films	1 (5.6)	0 (0)	6 (33.3)	11 (61.1)
B+F density of extraoral films	5 (27.8)	0 (0)	6 (33.3)	7 (38.9)
Darkroom lighting and safelight condition	2 (11.1)	1 (5.6)	10 (55.5)	5 (27.8)
Output measurements of x-ray sets	0 (0)	2 (11.1)	9 (50.0)	7 (38.9)
Monitoring of received dose by personnel	2 (11.1)	16 (88.9)	0 (0)	0 (0)

Table 4. Agreements of dental school status with guidelines of EC and NRPB in different aspects.

Item	Agreement N (%)	
	IR	ER
1- Utilizing the rectangular Collimator	2 (11.1)	--------
2- PID length	17 (94.4)	--------
3- Existence of protective covers	18 (100)	18 (100)
4- Policy for use of protective covers	5 (27.8)	4 (22.2)
5- Responsible person for radiography	12 (66.7)	16 (88.9)
6- Existence of radiation monitoring systems	17 (94.4)	17 (94.4)
7- Responsible person for holding disable patients	18 (100)	18 (100)
8- Regular measurements of films sensitivity	5 (27.8)	1 (5.6)
9- Measurements of darkroom lighting and safelight condition	3 (16.7)	2 (11.1)
10- personnel dose received monitoring	17 (94.4)	18 (100)
11- Quality control and output measurements of X-ray sets	0 (0)	2 (11.1)
12- Responsible person about quality control programs	13 (72.2)	13 (72.2)

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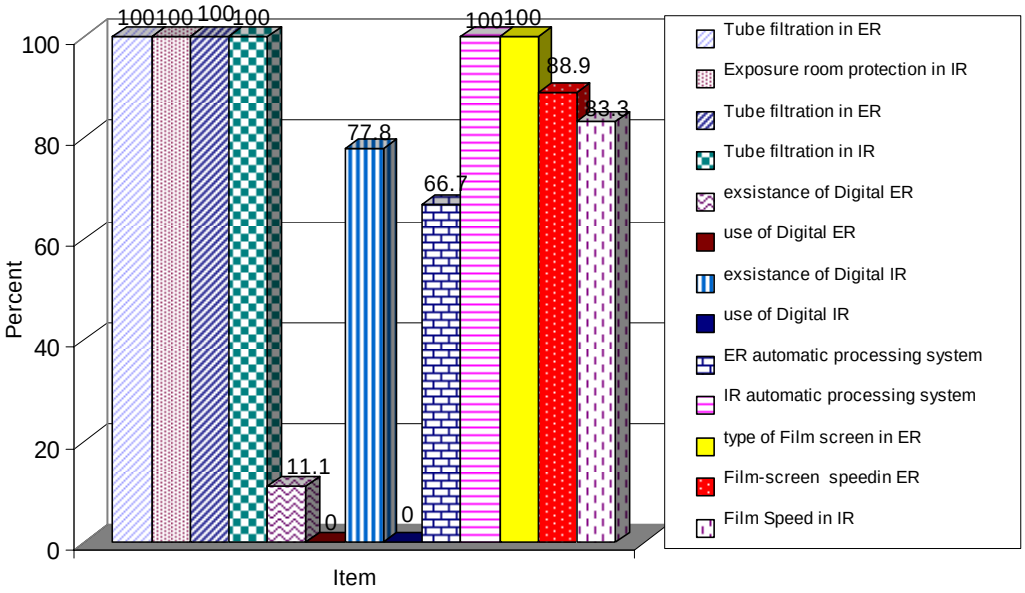

Figure 1. Agreements of dental school status with some of radiation protection guidelines.

DISCUSSION

The aim of dental radiography is to obtaining a high-quality image from oral and maxillofacial structures with the least exposure of the patient. Therefore, along with an increase in the diagnostic application of X-ray, more consideration should be given to radiation protection protocols [19].

Our finding, about radiation protection principles observance in intraoral radiography, has pointed out to a slightly better situation than that mentioned by other studies [19, 21-24]. Our study showed that E-speed radiographic film is used exclusively at 83.3% of institutions, and in combination with D-speed film at 16.3%. This has been in good agreement with the data presented by Kaviani *et al.* [19] in dental practices of Tabriz province (Iran) in 2005, and it showed an improvement over the results of Eskandarlou and Akhtari [21] and Tavakoli *et al.* [23] who reported about 70% use of E-Speed intraoral films in private dental offices of Hamadan (2001) and Tehran (2004) provinces, respectively. However, the increasing application of E-Speed films during the years is encouraging.

One of the most noticeable aspects of our study was the absence of rectangular collimator in intraoral radiography. The rectangular collimator of radiation beam limits the exposure area by a factor of three to four [5]. But, the results indicated that a few dental schools adhere to this order. Additionally, other studies in different provinces of Iran showed that rectangular collimator is not used at all [21-24]. It must be noted that all the above and below-mentioned studies have been carried out in private dental offices.

In the present study we found about 88.9% of dental X-ray equipments use the 70 kVp, an improvement of 35% compared to that reported by Sheykhi *et al.* [22] previously. The most common PID lengths were both 8 and 12 inches (38.9%). This was similar to the results previously reported for dental offices and practicing dentists by Eskandarlou [21], Sheykhi [22], Tavakoli *et al.* [23], Yaghmaiee and Talaeipoor [24].

To protect patients from X-ray, lead aprons and collars must be used. The main rule of a lead apron is absorption of scattered radiation and reduction of the dose received by patients [19]. Results of the present study on the use of leaded rubber aprons for all pregnant patients in intraoral and extraoral radiography is a positive finding, similar to the results obtained in

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other similar studies [19, 21-24]. However, majority of centers do not use a thyroid collar with the apron.

This study also has demonstrated that all centers employ rare earth intensifying screens in extraoral radiography, similar to the results obtained in other studies [22, 24]. The official EU and NRPB recommendations indicate that the use of filtration thickness of at least 1.5 mm Al results in considerable reduction in patient radiation exposure [20]. Our findings showed that all of intraoral and extraoral X-ray equipments had employed this amount of filtration. This aspect was not considered in other similar studies in Iran.

Majority of dental schools had digital equipments, but none of them utilized system due to printing problems, lack of picture archiving and communication systems (PACS), low tendency by dentists and adaptation of patients with former methods, as respondents' point of view.

All of dental schools were equipped with automatic processors. Whereas, Tavakoli *et al.* [23] and Yaghmaiee and Talaeipoor [24] showed that less than 10% of private dental offices have been equipped with automatic processors for IR purposes.

The fact that the majority of quality control exams are not being used by most of dental schools deserves some attention. None of dental schools had regular programs for inspection of film sensitivity; light leaks to darkroom, safe light condition, and output measurements of X-ray units. Quality control programs had been performed in the format of research projects occasionally. All other similar studies had confirmed this problem, as well [22, 24]. Finally, it must be noted that, educational centers had better equipments and instruments comparing with private offices in general.

In conclusion the emphasize of present study is on the need for further consideration of radiation protection principles, especially on the field of quality control and quality assurance programs in dental schools of Iran.

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REFERENCES

1. Quinn AD, Taylor CG, Sabharwal T, Sikdar T (1997) Radiation protection awareness in non-radiologists. *The British Journal of Radiology,* ***70:*** *102–106.*
2. Rahman N, Dhakam S, Shafqut A, Qadir S, Tipoo FA (2008) Knowledge and practice of radiation safety among invasive cardiologists. *Journal of Pakistan Medical Association,* ***58:*** *119-122.*
3. Ghazi-khanlou Sani K, Momennezhad M, Zakavi SR, Sabzevari S (2008-2009) Effects of lead aprons on decreasing the dose received by personnel in nuclear medicine departments. *Journal of Babol University of Medical Sciences,* ***10:*** *30-34.* (In Persian).
4. Shiralkar S, Rennie A, Snow M, Galland RB, Lewis MH, Gower-Thomas K (2003) Doctors' knowledge of radiation exposure: questionnaire study. *British Medical Journal,* ***327:*** *371-2.*
5. Sitra G, Daniel MJ, Srinivasan SV, Prashad KV (2008) Radiation protection protocol observed amoung dentist population in the union territory of Puducherry. *J Ind Aca Oral Med Radiol,* ***20:*** *45-48.*
6. George J, Eatouch JP, Mountford PJ, Koller CJ, Oxtoby J, Frain G (2004) Patient dose optimization in plain radiography based on standard exposure factors. *The British Journal of Radiology,* ***77:*** *858–863.*
7. Stavrianou K, Pappous G, Pallikarakis G (2005) A quality assurance program in dental radiographic units in western Greece. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod,* ***99:*** *622-7.*
8. Nakfoor CA (1992) Compliance of Michigan dentists with radiography safety recommendations. *Oral Surg Oral Msd Oral Pathol,* ***73:*** *510-513.*
9. Tugnait A, Clerehugh V, Hirschmann PN (2003) Radiographic equipment and techniques used in general dental practice. A survey of general dental practitioners in England and Wales. *Journal of Dentistry,* ***31:*** *197–203.*
10. Davies C, Grange S, Trevor M (2005) Radiation protection practices and related continuing professional education in dental radiography: A survey of practitioners in the North-east of England. *Radiography,* ***11:*** *255e261.*
11. Thunthy KH and Weinberg R (1995) Sensitometric comparison of Kodak EKTASPEED Plus, Ektaspeed, and Ultra-speed dental films. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod,* ***79:****114-6.*
12. Svenson B, Welander U, Shi XQ, Stamatakis H, Tronje G (1997) A sensitometric comparison of four dental X-ray films and their diagnostic accuracy. *Dentomaxillofac Radiolm,* ***26:*** *230-5.*
13. Peterson CA, Mauriello SM, Overman VP, Platin E,

[Downloaded from ijrr.com on 2026-09-13]

Tangen CM (1997) Effects of beam collimation on image quality. *J Dent Hyg, 71: 61-70.*
14. Geist JR and Katz JO (2002) The use of radiation dose-reduction techniques in the practices of dental faculty members. *Journal of Dental Education,* ***66:*** *697- 702.*
15. Geist JR, Katz JO (2002) Radiation dose–reduction techniques in North American dental Schools. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod,* ***93:*** *496-505.*
16. Mupparapu M (2005) Radiation protection guidelines for the practicing orthodontist. *Am J Orthod Dentofacial Orthop,* ***128:****168-72.*
17. European Commission (2004), European guidelines on radiation protection in dental radiology. The safe use of radiographs in dental practice. Radiation Protection, 136. (Luxembourg: Office for Official Publications of the European Communities).
18. National Radiological Protection Board (NRPB) (2001) Guidance notes for dental practitioners on the safe useof X-ray equipment. NRPB and Department of Health (London).
19. Kaviani F, Esmaeili F, Balayi E, Pourfattollah N (2007) Evaluation of X-ray Protection Methods Used in Dental Offices in Tabriz in 2005-2006. *Journal of Dental Research, Dental Clinics, Dental Prospects,* ***1:*** *49-52.*
20. Alcaraz M, Martynez-Beneyto Y, Perez L, Jodar S, Velasco E, Canteras M (2004) The status of Spain's dental practices following the European Union directive concerning radiological installations. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod,* ***98:****476-82.*
21. Eskandarlou A and Akhtari M (2003) Radiation protection principles observance in dental offices of Hamadan city in 2001. *Journal of Hamadan University of Medical Sciences,* ***10:*** *47-50.* (In Persian)
22. Sheykhi M (1995) Observance of radiation protection at dental offices of Isfahan. MSc thesis, Isfahan University of Medical Sciences, Iran.
23. Tavakoli MA, Nik-neshan S, Varsho-saz M (2004) Protection against X-ray in dental clinics of Shahid Beheshti University Medical Sciences in 2001. *Behesh Univ Den J,* ***22:*** *197-202.* (In Persian)
24. Yaghmaiee K and Talaeipoor A (1996) Radiation protection in dental radiography offices of Tehran city. MSc thesis, Azad University of Medical Sciences, Tehran, Iran.

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